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Process device for producing polarizer

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The invention pertains to technological apparatus for production of polarizers, obtained from lyotropic liquid crystals (LLC) based on organic compounds, in particular, dyes. The technological production line for polarizer formation comprises at least one system of formation of polarizer films from LLC of at least one organic compound, at least one system of local removal of the polarizer film material obtained from LLC of at least one organic compound, at least one substrate holder and at least one means of relative movement. Also introduced, an apparatus for formation of polarizer films from LLC of at least one organic compound and a system of localized removal of polarizer films obtained from LLC of at least one organic compound.

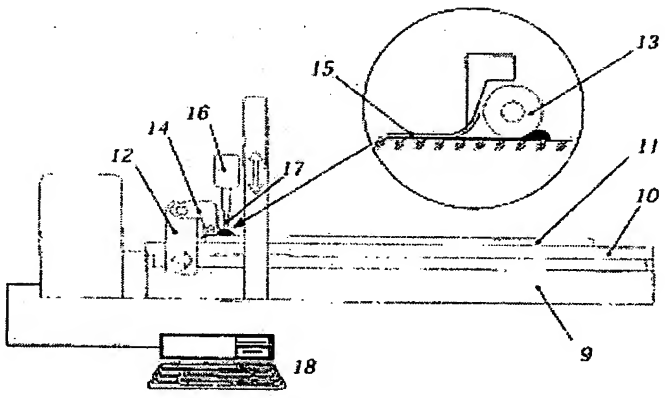

Fig. 2

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Description of corresponding document: **EP1174738**

[0001] The invention pertains to technological machinery for production of polarizers obtained from lyotropic liquid crystals based on organic compounds, particularly dyes.

[0002] There is a known polarizer, obtained on the basis of liquid-crystal solutions of organic dyes [1]. Polarizer, according to the herein technology, is obtained by application of thin film of liquid crystalline dye solution onto a glass or polymer substrate via one of the known methods. The distinction of this technology lies in that the orientation of the dye molecules occurs in the process of application of the film, so that a thin heat-resistant polarizing coating forms on the substrate immediately after drying. Such films could be used as polarizers in various optical devices. Their application allows creation of new designs of liquid-crystal displays, in which polarizers could form directly on the surface of liquid crystal cell, on the outside as well as on the inside.

[0003] Application of polarizers in displays bears certain peculiarities, related to their small thickness and hydroscopicity, as well as to the contemporary techniques of display manufacturing. Thus, for example, in case of external positioning of polarizers, they have to be protected by some means to prevent their mechanical damage. Moreover, the area, covered by the protective layer, should be larger than the area of the polarizer in order to completely avoid any contact of the polarizer with the surroundings and prevent penetration of moisture. In case of their placement inside the cell, polarizer should not be around the perimeter of the cell at the areas of adhering since it will compromise the quality of the adherence for once, and will contact with the surroundings, second. Therefore, polarizer should cover only the working area of the display and should not be at its peripherals. Taking into account that several displays are formed on a single substrate, a necessity to form a pattern on its surface arises. This could be performed by localized application of polarizer onto the substrate, or by the localized removal of the polarizing layer applied previously on the entire area of the substrate, preserving it on the proper regions of the substrate.

[0004] Various methods of application of the herein films and machinery allowing its implementation are known [2]. Application of LC solution could be implemented using slot, rod or roller. However, the known apparatuses do not allow obtaining polarizers with reproducible characteristics because of the difficulties of forming a uniform 15-10 mu m thickness wet layer film without lines and with uniform orientation of molecules over the entire working field of the substrate. Besides that, these apparatuses do not allow obtaining polarizers with polarizing layer applied on separate regions of the substrate.

[0005] There are known methods of forming a pattern of polarizing films based on lyotropic liquid crystal (LLC) compounds [3]. According to [3], the film is formed by a cylindrical engraved roller, in which the engraving is implemented as grooves on the surface of the roller within the boundaries of the pattern. The grooves get filled with LLC solution, which subsequently is transferred onto the surface of the substrate via rolling the roller over it. This method has the disadvantage that due to the high viscosity of the LLC, a roller with the diameter of no larger than 3 cm can be used to ensure quality of application. Therefore it is difficult to form patterns with linear dimensions along the direction of application larger than 10 cm. Besides that, the use of this method strongly depends on viscosity of LLC and the thickness of the forming film. In particular, the degree of orientation of molecules in thick films appears to be substantially worse than in thin ones. Therefore, in order to form a pattern on a polarizer, it is favorable to apply a layer of polarizer on the entire area of the substrate and later locally remove it from a part of the area, leaving the proper configuration of the polarizer.

[0006] Various methods of removing thin isotropic films from the surface of a substrate are known, either through mechanical removal on separate areas or using protective mask via etching [4]. However, all of them have a number of substantial disadvantages, which limit their applicability for removal of polarizing layers. In particular, the mechanical method requires frequent replacement or cleaning of the removed material from the working element, and constant evacuation of the dust formed in the process of operation. The methods of local removal of polarizing layer via etching or rinsing with the use of protective mask are less productive and more expensive since they include several additional technological stages, related to formation of the protective mask. Besides that, the application of the protective mask onto the polarizing layer and its subsequent removal invariably leads to worsening of the polarizer's structure.

[0007] The invention is focused on the development of an apparatus for producing a uniform thickness and molecular orientation layer of polarizer made of LC solutions on the entire area of the substrate as well as only on the desired regions of it.

[0008] The technical result of the invention is the creation of an apparatus for producing polarizing film made of LLC based on organic compounds on the surface of the substrate. The declared apparatus will provide an enhancement of molecular orientation in the polarizing material, an enhancement of its optical anisotropy, and, as a consequence, an enhancement of polarizing effectiveness with the same thickness of the film, enhancement of the thickness uniformity over the area, broadening of the range of speeds of application, within the limits of which no defect lines will form on the polarizer.

[0009] The technical result of the invention also is the creation of an apparatus for localized, mask-free removal of separate regions of polarizing layer. The process and apparatus provides: the possibility of forming polarizers on the desired regions of the substrate, while retaining unchanged all the functional characteristics of the remaining polarizing layer and its periphery as well as the previously introduced elements of the device on the substrate; exclusion of contamination of the working area of the polarizers and the substrate by the removed material; preserving the structure of the film, formation of a straight edge of the polarizing layer without disturbing the orientation of molecules in the near-edge area; and preserving the structure and integrity of the polarizing film along the edges of the removed areas as well as over the entire working area of the polarizer.

[0010] Technical result of the invention also is the creation of an apparatus, which allows applying the polarizing film onto the substrate and locally remove it in the proper regions while maintaining the integrity and structure of the film in the desired areas. Moreover, local removal of the film's material can be performed at any degree of moisture content in the film, which allows combining the processes of drying and material removal, maintaining the optimum regime of drying during the whole cycle of formation of polarizer. This not only enhances productivity due to reduction of production operations, but also enhances the quality of created polarizers, especially on the edge since the process of crystallization during drying leads to additional orientation of molecules including the regions along the edge. Therefore, localized removal of the film material not only does not cause formation of a damaged edge, but also provides an opportunity to "heal" the edges of the remaining layer due to the process of additional crystallization.

[0011] The technical result of the invention is achieved by the fact that in the apparatus for forming polarizer(s) from lyotropic liquid crystal(s) based on at least one organic compound, comprises at least one system of application of LLC onto at least one substrate, and at least one system of orienting force on LLC and/or on the molecules and/or on the supra-molecular complexes of the organic matter(s). The systems are installed with the possibility of relative movement with at least one substrate holder, at least one system of orienting force comprises at least one plate, one end of which is fixed so that upon relative movement of the plate and the substrate holder(s) at least a part of the plate surface freely translates over the surface of the applied film(s) providing the external orienting force on LLC and/or on the molecules and/or on the supra-molecular complexes of the organic matter(s).

[0012] In the above apparatus, at least one system of application can comprise at least one method of supplying LLC. At least one method of supplying LLC can involve at least one injector for supplying LLC, and/or at least one system of transmission rollers, and/or at least one channel with a metering dispenser. At least one system of application can comprise at least one element for application of LLC onto the substrate (s) implemented as at least one rotating roller and/or as at least one fixed roller and/or at least one slot and/or as at least one rod. On the surface of at least one roller there can be introduced a relief (a pattern). At least a part of the plate(s) surface can possess hydrophilic and/or hydrophobic qualities. On at least a part of the plate's (s') surface there can be introduced a relief (pattern). Plate(s) can be made out of polymer

materials or rubber, or at least two different materials, comprising separate parts of the plate(s) and/or comprising layers of plate(s). At least one system of application can be installed with the possibility of vertical movement relative to the substrate holder(s). At least one system of application can be installed with the possibility of horizontal movement relative to the substrate holder(s). One end of the plate(s) can be fixed on one or different holders with the system(s) of application or directly on at least one system of application. At least one system of application can be implemented as at least one fixed roller(s), which is installed with the possibility of movement to provide clasping of the plate(s) to the forming film(s). At least one system of orienting force can be additionally supplied with at least one means of clasping the plate(s) to the forming film. The plate(s) can be implemented in a rectangular shape. The apparatus can be additionally supplied with at least one anti-vibration system and/or a system of automatic control and/or control of the formation process.

[0013] Technical result is achieved also by the fact that in the apparatus of localized removal of the material of the polarizing film(s), obtained from LLC of at least one organic compound, at least one system of the solvent(s) supply is implemented as at least one directing channel, at least one system of solvent and/or products of reaction(s) and/or solution(s) removal implemented as at least one directing channel and installed with the possibility of connection to a system of discharging and/or vacuum system. Technical result is also achieved by the fact that in the apparatus, the system(s) of supply and the system(s) of removal can be installed so that their longitudinal axes are situated perpendicular to the plane of at least one substrate holder. System(s) of supply and system(s) of removal can be implemented with the possibility of vertical and/or horizontal movement. System(s) of supply and system(s) of removal on one hand and substrate holder on the other can be implemented with the possibility of relative movement. System(s) of supply and system(s) of removal can be installed fixed relative to each other or with the possibility of relative movement. System(s) of supply and system(s) of removal can be implemented as coaxial tubes where the inner diameter of the removal tube(s) is greater than the inner diameter of the solution(s') supply tube. System(s) of supply and system(s) of removal can be situated at a fixed distance from each other. The apparatus can be additionally supplied with a system of automatic control and/or control over the process of localized removal. The apparatus can be additionally supplied with at least one anti-vibration system.

[0014] Technical result of the invention is achieved due to the fact that the technological line of polarizer formation comprises at least one apparatus for formation of polarizing film(s) from LLC of at least one organic compound, at least one apparatus of localized removal of the polarizing film material obtained from LLC of at least one organic compound, at least one substrate holder and at least one means of their relative movement. Technical result of the invention is also achieved due to the fact that at least one apparatus for film formation in the technological line and the at least one apparatus of localized removal can be implemented according to the claims. At least one apparatus for formation of film(s) and at least one apparatus for localized removal and at least one substrate holder can be situated on one or separate bases. Technological line can be placed in a chamber or implemented in a single casing. Technological line can be additionally equipped with at least one manipulator for transfer and/or transportation of products. Technological line can additionally comprise at least one table for between-operation transfer and/or storing. Technological line can additionally be equipped with at least one means of drying, installed within at least one apparatus of the line, and/or between the apparatuses of the line, and/or in front of at least one apparatus for forming, and/or after at least one apparatus for localized removal, and/or above and/or below at least one substrate holder. At least one means of drying can be implemented as a heater or a system of air blowing or as a radiation system. Technological line can additionally comprise at least one anti-vibration means. Technological line can be additionally equipped with means of automatic control of the process and/or a system for control over the process.

[0015] The introduced technological apparatus can be built into a technological production line for manufacturing LC displays. The place of installment of this system into a production line will be

determined by the place of application of polarizers and related to its subsequent operations and will depend on whether polarizers are to be outside of the cell or inside. Here, the apparatus for application of polarizing coatings is implemented analogously as for the external as for the internal polarizers.

[0016] The key moment in the technology of formation of polarizing coatings from liquid-crystal solutions of organic matters is the fact that the orientation of the major axes of the molecular complexes, which are the structural and kinetic units in such solutions, in the volume of a liquid film coincides with the direction of the velocity vector of the liquid flow in the region of film formation. Therefore, any non-homogeneity of the velocity vector distribution throughout the volume of the liquid will lead to a non-homogeneities in the polarizing layer after its drying. Therefore, a major requirement to the apparatus for formation of the polarizer is that the system must provide uniform orientation of molecules throughout the volume of the film of LC solution in the process of application and its uniform thickness. Moreover, the thickness of the wet layer should be within the range 5 - 10 mu m.

[0017] To introduce the orientation of molecules, the method of application should provide shear or tension in the layer of the liquid, which immediately limits the number of methods of film application to the roller, rod, and slot methods.

[0018] The major condition for creation of a uniform molecular orientation in the layer of LC solution is the formation of a laminar, uniformly oriented flow of liquid in the gap between the surface of the substrate and the working element of the application system, and also rectilinearity of the line of detachment of the liquid from the working element of the application system at the exit from the region of film formation. Non-Newtonian rheological qualities of LC solution, high effective viscosity, which changes depending on the shearing speed and temperature from 1.5 to 0.5 Pa*s, and the high surface tension around 70 dyne/cm (dyne is a unit of force, 10<-5> newton), substantially hinder creation of such conditions. Upon application of liquids with such qualities in thin film, the lines of different thickness and molecular orientation easily appear.

[0019] Taking into account that the thickness of the wet film is within 10 mu m, special requirements are placed on the vibrational characteristics of the apparatus. Oscillations of the applying system along any direction will modulate the thickness of the film as well as the instantaneous distribution of the velocity vector in the liquid. Thus, for example, oscillations of the rod perpendicular to the plane of the plate will modulate the thickness of the film. Moreover, the instantaneous distribution of the liquid velocity vector will also be modulated and, as a consequence, so will be the local direction of the polarizing axes. Oscillations of the application system or the table in the horizontal plane, perpendicularly to the direction of application of the film, will modulate the direction of the cumulative velocity vector and, consequently, the direction of molecular orientation in the plane of the plate. Such oscillations can substantially affect the polarizing effectiveness of the obtained film. All this indicates that the requirements to the uniformity of movement of the application system or the table and to the absence of vibrations must be very high.

[0020] Therefore, determined in short, the following are the major features of formation of polarizers based on liquid-crystal solutions:

1. Small thickness of the formed wet layer of LLC (<10 mu m)
2. High effective viscosity of LLC (&tilde& 0.3 Pa*s)
3. Low level of vibrations (<1 mu m perpendicular to the plane of the substrate)
4. High uniformity of movement of the application system and the table.

[0021] The essence of the invention is explained in Figures 1 through 6.

[0022] Figure 1 illustrates the general schematic of the technological line for formation of polarizers from a liquid-crystal solution.

[0023] Figure 2 illustrates the apparatus for formation of polarizing films.

[0024] Figure 3 illustrates the method of mounting the orienting system.

[0025] Figure 4 illustrates the apparatus for formation of polarizing films at a certain angle to the edges of the substrate.

[0026] Figures 5a and 5b illustrate apparatus for localized removal of the polarizing film material.

[0027] Figure 6 illustrates the apparatus comprising a group of systems for local removal of the polarizing material.

[0028] The major parts of the apparatus for application of polarizing coating (Figure 1) are: the stand 1 (the base), on which all the working systems are situated, table 2 (substrate holder) for substrate placement, the system of polarizing film formation 3, the system of localized removal of the polarizing film material 4, the system of zonal drying 5, means of the relative mechanical movement of the table on the stand (not shown), the control block 6, anti-vibration system 7, the means to protect the working area from dust 8. Additionally to that, the apparatus can comprise a system of automatic supply onto the table and removal from it of the working substrates, the LLC and the working area temperature stabilizer, as well as any other systems and mechanisms providing automatic processing of substrates, enhancing the quality of polarizers or productivity of the apparatus. In Fig. 1, the system of zonal drying is situated between the system of formation and the system of local removal, and provides optimum moisture of the polarizing layer at removal. However, the system of local removal of polarizing layer can be situated directly after the application system or on it, removing the wet film of LLC off the substrate in the required places.

[0029] Depending on the construction of the display, as a rule, a certain orientation of the polarizing film's polarization axis relative to other elements' optical axes is necessary. This makes it necessary to apply the polarizer at an angle to the sides of a rectangular substrate other than 0 DEG and 90 DEG . Therefore, the table for substrate placement can have means for horizontal turning of its plane relative to the direction of movement.

[0030] The major operations, which are performed by the apparatus, are the preliminary application of the LLC solution onto the substrate, its distribution over the surface into a thin oriented layer, additional orientation, change of substrate orientation to a desired angle, local removal of the polarizing film material, turning of the substrate to 90 DEG , and second local removal of polarizing film material. Depending on the angle of orientation of the sides of the substrate relative to the direction of movement, and also on the method of application of polarizer, some operations can be eliminated or be performed simultaneously. In a more general case, when the substrate is oriented arbitrary, application of polarizing film is performed in two stages: formation of continuous layer over the entire surface of the working substrate (which further could be used as one of the plates in a display) and removal of the polarizer from the part of the surface preserving it only in the desired places. The sequence of operations in the apparatus shown in Fig. 1 is as follows. The substrate is situated on the table 2, and LLC is applied on it. Upon movement of the substrate, the polarizing coating is formed, and, if it is necessary, additional orientation is performed. After the substrate exits the system of application, it is rotated from the position in which two its sides were oriented at an angle to the direction of movement, to a position where those sides are oriented parallel to the direction of movement. Upon further movement, the substrate enters the zone of operation by apparatus 4, of local removal of the material of the polarizing film, and the film is removed from the substrate in the desired places. Reaching the end of the apparatus, the table turns to 90 DEG and moves backwards. Here,

the removal of the polarizer happens in the direction perpendicular to the direction of the first removal. The table moves to the initial position where the processed substrate is replaced by a new one. In case when the removal system is situated directly in the system of film application, the apparatus is more compact (has smaller size), since maximum travel distance of the substrate is limited only by the dimension of the substrate's diagonal, whereas in the previous case this distance has to be twice more. However, in this configuration, the substrate has to travel two cycles of movement to fully complete the process of polarizer formation: formation of the continuous film upon movement from left to right, first local removal of polarizer upon the reverse movement, the second removal upon the second cycle of movement from left to right and an idle movement to return the substrate to the initial position.

[0031] To increase productivity, the apparatus can have such table size, that several substrates could be placed on it. Here the apparatus can have corresponding number of application and removal systems so that polarizers are formed simultaneously and independently on each substrate.

[0032] Figure 2 illustrates the system for application of the polarizer, in which the working element, creating the oriented film of the polarizer, is a rod. The major elements of the system are the stage 9, on which the table 10, equipped with the vacuum fastener of the working substrate and the system of transportation of the carriage 12 are situated. The table should be equipped with braces for precise placement of the substrate. Carriage 12 serves to have the rod 13 mounted on it using holder 14. The rod holder must provide its easy installment, rigid fixture and adjustable uniform clasping of the surface of the substrate along its entire length. Besides that, the holder can have element 15 fixed on it, which provides additional orienting force on the film of LLC.

[0033] The stage 9 also has system 16 situated on it, which is used for application of LLC onto the substrate in the form of a line along the entire length of the rod. The system 16 for LLC application represents a reservoir with LLC, from which LLC is supplied at a required pressure onto the surface of the substrate via a tube through a calibrated needle-like tip 17. The tip can travel with the required speed across the substrate along its entire width. Control over the apparatus is performed from the control desk 18.

[0034] The stage of the apparatus is placed on a table with anti-vibration protection.

[0035] Operation of the apparatus is performed in the following sequence. Initially the carriage is situated at the far left position so the rod 13 is beyond the boundaries of the substrate 11 and propped up above it. At this time the tip 17 of the system 16 for application of LLC, through which the later is supplied onto the substrate, is situated at the edge of the substrate in the upper position. At the start of the operation the tip is lowered to a desired height, the solution under pressure is feed into the channel of the tip and, when the solution starts to pour onto the surface of the substrate the tip starts to move across it with the desired speed. The quantity of the applied material will be determined by the pressure and the speed of movement of the tip. Upon reaching the edge position the tip is lifted and returned to the initial position. The carriage starts to move and when it reaches the edge of the substrate, the rod is lowered and starts to spread the solution over the surface of the substrate with the desired speed. During that, the element 15 produces additional orienting affect on the wet film, removing disturbances in the molecular orientation, induced at the phase of application of the polarizing film by the rod. Reaching the extreme left position, the carriage stops. During that, the rod is lifted and the carriage is returned back to the initial position.

[0036] In the capacity of the rod a so-called Mayer rod can be used, which represents a metal bar with a calibrated wire of circular cross section reeled tightly on it. Such rod allows obtaining films of the necessary thickness and high degree of uniformity. The orientation of molecules at the same time has some function of distribution induced by the periodical structure of the rod's surface. Such orientational distribution of molecules worsens polarizing characteristics, which is especially noticeable in thick films. Introduction of the additional orienting element 15 allows eliminating this drawback, making orientational

distribution of molecules more uniform.

[0037] The element for additional orienting element 15 represents a flexible thin plate (or a film) of an organic material having smooth and even surface. During application of the polarizing coating the plate touches the surface of LLC and slides over it creating the additional, uniform over the entire width of the substrate, orienting force on the molecules of LLC due to the surface tension forces. The length of the plate in contact with the film of the LLC is selected so as to achieve the best orientation of molecules and lies in the range of 1 to 500 mm.

[0038] Various methods can be used for attachment of the element 15 relative to the rod in the apparatus. Figure 3 illustrates placement of the element 15 between the rod 13 and the substrate 11. In this case it is especially convenient to use the roller with an elastic coating in the capacity of the rod since it allows eliminating non-homogeneity of the polarizing film's thickness introduced by the disturbances in the surface of the substrate 11. This is especially important during application onto substrates of large size where it is difficult to provide uniform clasping of the rod to the surface of the substrate 11 due to the unavoidable curvatures of the substrate itself as well as the axis of the rod. The thickness of the layer of polarizer then will be determined by the elasticity of the rod's elastic coating, the speed of the rod's movement, viscosity LLC and the force of pressing the rod to the substrate.

[0039] Figure 4 illustrates an apparatus for application of polarizing coating in the case when the optical axis of polarization should make a certain angle (from 0 DEG to 90 DEG) with the edges of the display. Formation of polarizing coating happens in two stages. First, application roller 19 applies a layer of dye onto substrate 11, then the dye is distributed into a layer of required thickness and oriented by the polymer plate 15, which is pressed against the substrate by the elastic roller 20. The dye 21 is captured by the roller 22 and transmitted onto the mantle roller 23, the surface of which has a deepening so that the protruding part has a reaming in the shape of the substrate. The dye, on the protruding part will be transmitted onto the application roller 19 and further onto the substrate 11. The substrate is fixed on the rotating table 24 with vacuum fastening. Application and orientation of the film happens during movement of the table. After the substrate travels outside the boundaries of the application system, the table is rotated to a certain angle so that two sides of the substrate are parallel to the movement of the table. Then the table travels further and the substrate enters the apparatus for removing polarizer in the necessary regions.

[0040] Figure 5 illustrates two examples of implementation of an apparatus for localized removal of the material of the polarizing film, based on one principle: diluting the film with water in the required region and its removal with a vacuum pumping. The difference lies only in the method used to create the excess pressure of water during its feeding to the required region of the substrate. In the system shown in Figure 5a the water is feed under pressure created via various methods; in the second system shown in Figure 5b the pressure in the water is introduced by the rarefication created by the vacuum suction.

[0041] In the apparatus shown in Figure 5a the water from reservoir 25 is feed into the tube 27 via pump 26, it then dilutes the film of the dye and is removed by a vacuum pump through tube 28.

[0042] In the apparatus shown in Figure 5b there is one channel, open from the side of the substrate 11. During the approach of the apparatus to the substrate, a lower pressure is created in the tube 30, the water is sucked from the reservoir 31 into the channel 29, it then dilutes the film of the dye and is removed through the tube 30. Valve 33 controls the water consumption.

[0043] Independently from the method of creation of the excess pressure in the water such working elements can be grouped into a complex of elements (Figure 6). In this case they will work simultaneously and remove regions of a film or films of polarizers by strips. It would be convenient to install two groups of such elements in the apparatus for application, one of which will be operating during the forward

movement of the table and the other during backward movement. The distance between the elements in one group would then correspond to the width, while in the other to the length of the displays.

[0044] In both cases, the proposed apparatus allows removing the polarizing film independently of its moisture content. The optimum moisture content of the film is picked with the condition of high rate of removal and maintaining sharp edge and high degree of orientation in the boundary region.

[0045] The condition of implementation feasibility of such method of polarizer removal is determined by the rate of dilution of the polarizing material and the rate of removal of the created solution in comparison to the rate of application of the polarizing layer. The rate of application depending on the viscosity of LLC solution can be from 5 to 200 mm/second. For this range of rates and the distance between the water feeding and vacuum pumping channels of 1 cm, the time of contact between the water and the polarizer is between 2 and 0.05 second. As shown by experiment, controlling the rate of the water feed and solution vacuuming, it is possible to achieve complete removal of a dry polarizing film of about 1 mu m thick, which proves technical feasibility of the herein method of localized removal of polarizing coating.

[0046] Conducted research had confirmed the high quality of the obtained polarizers, high degree of anisotropy and high polarizing effectiveness. During localized removal of the polarizing material the edges and the surface of the remained regions had perfect structure and the regions themselves had uniform thickness over their area. Investigations showed that the listed above technical results for each of the apparatus' were achieved.

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Claims of corresponding document: **EP1174738**

1. An apparatus for formation of a polarizer from lyotropic liquid crystal(s) (LLC) based on at least one organic compound, said apparatus comprising at least one system for application of LLC onto at least one substrate, at least one system for influencing the orientation of LLC and/or the molecules and/or the molecular complexes of the organic matter(s), wherein the appointed systems are capable of relative displacement with respect to at least one substrate holder, and wherein at least one system influencing the orientation comprises at least one lamina, one end of which is fixed such that during relative displacement of the lamina and the substrate holder(s) at least a part of the lamina surface travels unrestricted over the surface of the applied film(s) providing the external orienting influence on LLC and/or molecules and/or supra-molecular complexes of the organic matter(s).

2. An apparatus as claimed in claim 1, wherein at least one system of application comprises at least one means of feeding LLC.

3. An apparatus as claimed in claim 1 or claim 2, wherein the at least one means of feeding LLC comprises at least one sprayer for feeding LLC and/or at least one system of transmitting rollers and/or at least one channel with feed dosimeter.

4. An apparatus as claimed in any one of the preceding claims, wherein the at least one system of application comprises at least one element for application of LLC onto the substrate(s) implemented as at least one rotating roller and/or as at least one fixed roller and/or as at least one philier and/or as at least one rod.

5. An apparatus as claimed in claim 4, wherein on the surface of the at least one roller there is a relief.

6. An apparatus as claimed in any one of the preceding claims, wherein at least a part of the surface of the lamina(s) possesses hydrophilic or hydrophobic qualities.

7. An apparatus as claimed in any one of the preceding claims, wherein at least on a part of the surface of the lamina(s) there is a relief.

8. An apparatus as claimed in any one of the preceding claims, wherein the lamina(s) is/are made out of a polymer material and/or a rubber material or at least two different materials comprising separate parts of the lamina(s) and/or comprising the layers of the lamina(s).

9. An apparatus as claimed in any one of the preceding claims, wherein at least one system of application is installed with the possibility of vertical displacement relative to the substrate holder(s).

10. An apparatus as claimed in any one of the preceding claims, wherein at least one system of application is installed with the possibility of horizontal displacement relative to the substrate holder(s).

11. An apparatus for local removal of a polarizing film(s) material, obtained from LLC comprising at least one organic compound, said apparatus comprising at least one system for feeding solvent(s) of the film material, implemented as at least one directing channel, at least one system for removal of the solvent and/or products of reaction and/or solution, installed with the possibility of connection to a system of rarefication and/or to a vacuum system and implemented as at least one channel.

12. An apparatus as claimed in claim 11, wherein the system(s) for feeding and the system(s) for removal are implemented with the possibility of vertical and/or horizontal displacement.

13. A technological line for formation of polarizers, said technological line containing at least one system for formation of polarizing films, obtained from LLC comprising at least one organic compound, at least one system for local removal of polarizing film material, obtained from LLC of at least one organic compound, at least one substrate holder and at least one system for their relative displacement.

14. A technological line as claimed in claim 13, wherein the at least one apparatus for formation of films is as defined in any one of claims 1-10.

15. A technological line as claimed in claim 13 or claim 14, wherein the at least one system for local removal is as defined in claim 11 or claim 12.

16. A technological line as claimed in any one of claims 13 to 15, wherein the at least one system for formation of films and the at least one system for local removal and the at least one substrate holder are situated on a single or different bases.

17. A technological line as claimed in any one of claims 13 to 16, wherein the technological line is placed in a chamber and is implemented in a single casing.

18. A technological line as claimed in any one of claims 13 to 17, wherein it is additionally equipped with at least one means of drying, installed in at least one apparatus of the line and/or space between apparatus in the line and/or before at least one apparatus of formation and/or after at least one apparatus of local removal and/or above and/or below at least one substrate holder.

19. A technological line as claimed in claim 18, wherein the at least one means of drying comprises a heater or a system of air blowing or a system of radiation.

20. A polarizer obtainable from the apparatus and/or technological line as defined in any one of the preceding claims.

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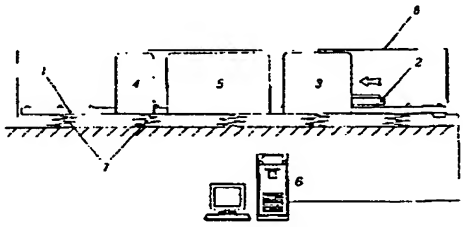
[54]发明名称 用于偏振镜生产的工艺装置

[57]摘要

本发明适用于制作基于有机化合物、特别是染料的易溶液晶（LLC）获得的偏振镜的工艺装置。用于形成偏振镜的生产线，包括至少一个从至少一种有机化合物的易溶液晶形成偏振镜膜的系统、至少一个定位清除从至少一种有机化合物的易溶液晶得到的偏振镜膜材料的系统、至少一个基片夹持器和至少一个相对移动装置。还引入了，用来从至少一种有机化合物的易溶液晶形成偏振镜膜的装置，以及定位清除从至少一种有机化合物的易溶液晶得到的偏振镜膜的系统。



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权 利 要 求 书

1. 用于从基于至少一种有机化合物的易溶液晶（LLC）形成偏振镜的装置，包括至少一个涂敷 LLC 到至少一种基片上的系统、至少一个对 LLC 和/或分子和/或有机物质的分子复合物的取向有影响的系统，所述的系统被安装成与至少一个所述的基片夹持器具有相对移动的能力，其特征是至少一个取向作用系统包括至少一个薄片，其一端固定，以便在薄片和基片夹持器相对移动的过程中，至少一部分薄片的表面在涂敷的膜的表面上不受限地移动，以提供对 LLC 和/或分子和/或有机物质的超分子复合物的取向的附加影响。

2. 根据权利要求 1 所述的装置，其特征是至少一个涂敷系统包括至少一个供给 LLC 的装置。

3. 根据权利要求 2 所述的装置，其特征是至少一个供给 LLC 的装置包括至少一个供给 LLC 的喷涂装置和/或至少一个传送辊系统和/或至少一个带有进给剂量器的通道。

4. 根据权利要求 1-3 中任何一项所述的装置，其特征是至少一个涂敷系统包括至少一个采用至少一个旋转辊和/或至少一个固定辊和/或至少一个狭槽（philier）和/或至少一个棒的用来涂敷 LLC 到基片上的组成部件。

5. 根据权利要求 4 所述的装置，其特征是在至少一个辊的表面具有浮雕。

6. 根据权利要求 1-5 中任何一项所述的装置，其特征是至少一部分薄片的表面具有亲水或亲油性质。

7. 根据权利要求 1-6 中任何一项所述的装置，其特征是至少在一部分薄片的表面上具有浮雕。

8. 根据权利要求 1-7 中任何一项所述的装置，其特征是所述的薄片是由聚合物材料或橡胶或至少两种不同的材料，构成所述的薄片的独立部分和/或构成薄片的层制造的。

9. 根据权利要求 1-8 中任何一项所述的装置，其特征是至少一个涂敷系统安装成相对于所述的基片夹持器具有垂直位移的能力。

10. 根据权利要求 1-9 中任何一项所述的装置，其特征是至少一个涂敷系统安装成相对于基片夹持器具有水平移动的能力。

11. 用于定位清除由至少一种有机化合物的 LLC 得到的偏振膜材料的装置，包括至少一个膜材料溶剂的进给系统，采用至少一个导管、至少一个溶剂和/或反应产物和/或溶液清除系统，可连接到负压系统和/或真空系统，并采用至少一个管路。

12. 根据权利要求 11 所述的装置，其特征是进给系统和清除系统可以垂直和/或水平位移。

13. 形成偏振镜的生产线，包括至少一个从至少一种有机化合物的 LLC 得到的偏振膜的形成系统、至少一个从至少一种有机化合物的 LLC 得到的偏振膜材料的定位清除系统、至少一个基片夹持器和至少一个它们的相对位移系统。

14. 根据权利要求 13 所述的生产线，其特征是至少一个膜形成装置是采用根据权利要求 1-10 所述的装置。

15. 根据权利要求 13 或 14 所述的生产线，其特征是至少一个定位清除系统是采用根据各项权利要求之一的装置。

16. 根据权利要求 13-15 中任何一项所述的生产线，其特征是至少一个膜形成系统和至少一个定位清除系统和至少一个基片夹持器位于单个或不同的基座上。

17. 根据权利要求 13-16 中任何一项所述的生产线，其特征是生产线放置在仓内并且采用保护性外壳。

18. 根据权利要求 13-16 中任何一项所述的生产线，其特征是附加装备有至少一个干燥装置，安装在生产线的至少一个装置中、和/或在生产线的装置之间的位置、和/或在至少一个形成装置之前、和/或在至少一个定位清除装置之后、和/或在至少一个基片夹持器之上和/或下。

19. 根据权利要求 18 所述的生产线，其特征是至少一个干燥装置采用加热器或鼓风机系统或散热器系统。

说 明 书

用于偏振镜生产的工艺装置

本发明所属技术领域

本发明适用于基于有机化合物，特别是染料的易溶液晶生产偏振镜的工艺装置。

与本发明相关的背景技术

已知一种以有机染料的液晶溶液为基础得到的偏振镜[1]。用这种技术，用另一种已知方法将液晶染料溶液薄膜涂敷到玻璃或聚合物基片上获得偏振镜。这种技术的特征在于染料分子的取向在涂敷膜的过程中发生，因此干燥后立即在基片上形成耐热偏振薄涂层。这种膜可在各种光学装置中用作偏振镜。可应用于液晶显示器的新设计，其中偏振镜可直接在液晶盒（liquid crystal cell）的表面、外部和内部形成。

与显示器制造的现代技术一样，在显示器中偏振镜的涂敷有着一定的与其小厚度和吸水性有关的特征。因此，例如，在偏振镜位于外部的情况下，它必须采用某些保护装置以防机械性破坏。进一步说，防护层覆盖的区域，应该比偏振镜区域更大，以便完全防止偏振镜与环境的任何接触,并防止水分的穿透。在其位于液晶盒内部的情况下，在粘结区域偏振镜不应环绕液晶盒周界，这是由于它将危及粘结质量，并且其次，将与周围接触。因此，偏振镜应该只覆盖显示器的工作区域并不覆盖其周围。考虑到少数显示器由单一基片形成，提出了在其表面形成图案的必要性。这可通过将偏振镜定

位涂敷于基片上，或通过定位清除预先涂敷于基片整个表面的偏振层进行，在基片的适当区域对它进行保护。

对于这种膜已有多种涂敷方法及装置[2]。LC 溶液的涂敷可利用狭槽（slot）、棒或辊实现。但是，由于难于形成均匀的 15-10 μm 厚的没有线、并且在整个基片的工作范围内分子均匀取向的湿涂层膜，已知装置不允许得到具有可重复的特性的偏振镜。除此之外，这些装置不允许得到偏振层涂敷于基片的分开区域上的偏振镜。

已知形成基于易溶液晶（LLC）化合物的偏振膜图案的方法[3]。根据[3]，膜通过圆柱形雕刻辊形成，其中雕刻采用在图案的边界之内的辊表面的凹槽。凹槽充满 LLC 溶液，它接着通过辊滚过基片表面被转移到基片表面上。由于 LLC 的高粘度，使这一方法有缺点，可用于具有不长于 3cm 直径的辊以保证涂敷的质量，因此难于形成具有沿着涂敷方向长度尺寸大于 10cm 图案。除此之外，这一方法的使用，很大程度依赖于 LLC 的粘度和形成的膜的厚度。尤其是，在厚膜中分子取向度明显比在薄膜中差。因此，为了在偏振镜上形成图案，合适的方法是在基片的整个表面涂敷一层偏振镜，并随后从部分表面定位清除，留下适当的偏振镜图形。

已知多种从基片表面清除薄的各向同性膜的方法，不是通过在分离区域的机械清除，就是在蚀刻中使用掩膜（protective mask）。但是，它们都有许多明显的缺点，这限制了它们的清除偏振层的适用范围。尤其是，机械方法需要频繁地从工作部件清掉被清除的材料，并且要不断消理在加工过程中形成的粉尘。通过使用掩膜的蚀刻或漂洗以定位清除偏振层的方法，由于它们包括几个与形成掩膜有关的工艺步骤，造成生产能力较低并且成本较高。除此之外，在偏振层上掩膜的使用及后续的清除，不可避免地会导致偏振镜结构一定程度的破坏。

发明内容

本发明的目的是开发用来生产在基片的整个表面以及只在其所需的区域、用 LC 溶液制成厚度和分子取向均匀的偏振镜层的装置。

本发明的技术结果是用来生产在基片表面、基于有机化合物的 LLC 制成的偏振膜的装置的创新。所提出的装置可改善偏振材料中分子取向、光学各向异性，以及，作为结果，可使具有相同厚度的膜的偏振效率提高，整个表面厚度均匀性提高，在不造成偏振镜上形成缺陷纹的限制条件下的涂敷速率范围扩展。

本发明的技术结果也在于用于对定位的、偏振层的分离区域的无掩膜清除的创新。工艺过程和装置提供：在保持被保留的偏振层及其周围以及在基片上预先引入的部件的所有功能特性不变的同时，在基片的所需要的区域形成偏振镜的可能性；除去被清除材料对偏振镜的工作区域和基片的污染；保持膜的结构，形成偏振层的直边而不干扰临近边缘区域的分子的取向；并且保持沿着清除区域边缘以及在偏振镜的整个工作区域上的偏振膜的结构和完整性。

本发明的技术结果还在于这样一种装置的创造，它允许涂敷偏振膜到基片上，并在适当区域定位清除，同时，在所希望的区域保持膜的完整性和结构。此外，膜材料的定位清除可在膜中水分含量的任何阶段进行，这允许将干燥和材料的清除过程结合起来，在整个偏振镜形成的周期中保持干燥的最佳状态。这不仅由于生产操作的减少提高生产率，而且因为在干燥过程中的结晶过程导致包含沿着边缘区域的附加的分子取向，提高生成的偏振镜，特别是在边缘的质量。因此，膜材料的定位清除，不仅没有形成破坏的边缘，而且由于附加的结晶过程，提供了“修复”保留涂层边缘的机会。

本发明的技术结果，实际上在用来从基于至少一种有机化合物的易溶液晶形成偏振镜的装置中获得，这种装置包括至少一个将LLC涂敷到至少一种基片上的系统，和至少一个在LLC上和/或在分子上和/或在有机物质的超分子复合物上的取向力系统。系统的安装与至少一个基片夹持器具有相对位移的可能性，至少一个取向力系统包括至少一个薄片，其中一端固定，以便在薄片和基片夹持器相对移动时，至少一部分薄片表面在涂敷的膜的表面不受限地移动，以提供在LLC上和/或在分子上和/或在有机物质的超分子复合物上的附加的取向力。

在上述装置中，至少一个涂敷系统可包括至少一种供给LLC的方法。至少一种供给LLC的方法可包括至少一个用来供给LLC的喷嘴，和/或至少一个传送辊系统，和/或至少一个带有进给剂量器的通道。至少一个涂敷系统可包括至少一个采用至少一个旋转辊和/或至少一个固定辊和/或至少一个狭槽和/或至少一个棒的用来将LLC涂敷到基片上的部件。在至少一个辊的表面可以引入浮雕花纹（图案）。在至少一部分薄片（plate）表面上可具有亲水和/或亲油性质。在至少一部分薄片表面上可以引入浮雕花纹（图案）。薄片可用聚合物材料或橡胶，或至少两种不同的材料，制成薄片的独立部分和/或制成薄片的层。至少一个涂敷系统可安装成具有相对于基片夹持器可垂直移动。至少一个涂敷系统的安装可相对于基片夹持器水平移动。薄片的一端可以固定在一个或不同的具有涂敷系统的夹持器上，或直接在至少一个涂敷系统上。至少一个涂敷系统可采用至少一个安装成具有提供夹紧形成的膜的薄片的移动的能力的固定辊。至少一个取向力系统可附加装有至少一种夹紧薄片和形成的膜的装置。薄片可采用矩形形状。装置可附加装有至少一个抗振系统和/或自动控制和/或形成过程的控制系统。

技术结果实际上也是借助定位清除从至少一种有机化合物的LLC得到的偏振膜材料的装置获得的，至少一个溶剂进给系统采用

至少一个导管、至少一个溶剂和/或反应产物和/或溶液清除系统采用至少一个导管，可连接到输送和/或真空系统。技术结果实际上还通过可安装进给系统和清除系统使其纵轴处于垂直于至少一个基片夹持器的平面的位置的装置中达到。进给系统和清除系统可具有垂直和/或水平移动的能力。在一侧的进给系统和清除系统和在另一侧的基片夹持器可具有相对位移的可能性。进给系统和清除系统可安装成彼此相对固定或具有相对移动的可能性。进给系统和清除系统可采用其清除管线内径大于溶液供给管线内径的同轴管线。进给系统和清除系统可处于彼此距离固定的位置。装置可附加装有自动控制和/或控制整个定位清除过程的系统。装置可附加装备有至少一个抗振系统。

本发明的技术结果，由形成的偏振镜的生产线包括至少一个用来从至少一种有机化合物的 LLC 形成偏振膜的装置、至少一个定位清除从至少一种有机化合物的 LLC 得到的偏振膜材料的装置、至少一个基片夹持器和至少一种它们相对移动的装置而获得。本发明的技术结果也由于事实上至少一个在生产线中用来形成膜的装置和至少一个定位清除装置可采用根据权利要求的装置达到。至少一个用来形成膜的装置、至少一个用来定位清除的装置以及至少一个基片夹持器可处于一个或分开的基座上。生产线可放置在仓内，或采用保护性外壳。生产线可附加装备至少一个操作装置，用于传送或运输产品。生产线可附加包括至少一个工作台，用于操作之间的传送和/或储存。生产线可附加装备至少一种干燥装置，安装在生产线的至少一个装置中，和/或在生产线的装置之间，和/或在至少一个用来形成的装置之前，和/或至少一个用来定位清除的装置之后，和/或在至少一个基片夹持器之上和/或之下。至少一种干燥装置可采用加热器或鼓风机系统或通过散热器系统。生产线可附加包括至少一种抗振装置。生产线可附加装备过程的自动控制装置和/或控制整个过程的系统。

引入的工艺装置可作成用来制造LC显示器的生产线。这一系统安装到生产线中的位置由应用偏振镜的位置确定，并与其后续操作有关，而且取决于偏振镜是在液晶盒外部还是内部。这里，对于外置和内置偏振镜，采用相似的涂敷偏振涂层的装置。

在从有机物质的液晶溶液形成偏振涂层的技术中的关键因素，实际上是作为这种溶液中的结构和运动单元的分子复合物的主轴的取向，在液膜的容积中与在形成膜的区域中液体流动速度的矢量方向重合。因此，全部液体容积中的任何速度矢量分布的不均匀性，在其干燥后都将导致在偏振层中的不均匀性。所以，对于用来形成偏振镜装置的主要要求，就是该系统必须提供在涂敷过程中的液晶溶液膜的全部容积中分子的均匀取向及其均匀厚度。进一步，湿涂层的厚度应该在5-10μm的范围之内。

为了引入分子的取向，涂敷的方法应该提供在液体层中的剪切或拉伸，这直接将涂敷膜的方法限定为辊、棒、和开槽（slot）的方法。

在LC溶液涂层中产生均匀分子取向的主要条件是形成层流，在基片表面和涂敷系统的工作部件之间的均匀取向液体流动，还有，在从膜形成区域离开时，液体从涂敷系统的工作部件脱离的线路的直线性。液晶溶液的非牛顿流变性质、高有效粘度，取决于剪切速率和温度从1.5到0.5Pa*s变化，以及约70达因/厘米（达因是力的单位，10^{-5}牛顿）的高表面张力，事实上阻止产生这种条件。当在薄膜中涂敷具有这种性质的溶液时，容易出现不同厚度和分子取向的线。

考虑到湿膜的厚度在10μm之内，在装置的振动特性上提出了特殊的要求。涂敷系统沿着任何方向的振动都将调节膜的厚度以及在液体中的速度矢量的瞬时分布。因此，例如，垂直于薄片平面的棒的振荡会调节膜的厚度。进一步说，也会调节液体速度矢量的瞬

时分布，并且，作为结果，这将是偏振轴的局部方向。在水平平面上涂敷系统或工作台的振荡，垂直于膜的涂敷方向，会调节附加速度矢量的方向，以及，必然地，影响在薄膜的平面中的分子取向方向。这种振荡可显著地影响得到的膜的偏振效率。所有这些表明，对于涂敷系统或工作台的移动均匀性，以及避免振动的要求很高。

因此，可简单地确定，形成基于液晶溶液的偏振镜的主要特点如下：

1. 形成的 LLC 湿涂层的小厚度（<10 μm）

2. LLC 的高有效粘度（~0.3Pa*s）

3. 低水平振动（垂直于基片平面<1 μm）

4. 涂敷系统和工作台的高均匀性移动。

附图简要描述

本发明的要点通过图 1 到 6 得到说明。

图 1 用来从液晶溶液形成偏振镜的生产线的总示意图。

图 2 用来形成偏振膜的装置图。

图 3 取向系统安装方法示意图。

图 4 形成与基片边缘成一定角度的偏振膜的装置示意图。

图 5a 和图 5b 用来定位清除偏振膜材料的装置的示意图。

图 6 由一组用来定位清除偏振材料的系统构成的装置。

具体实施方式

用来涂敷偏振层的装置（图 1）的主要部分是：支架 1（基座），所有工作系统装于其上，工作台 2（基片夹持器）用来放置基片，形成偏振膜的系统 3，定位清除偏振膜材料的系统 4，带状干燥系统 5，工作台在支架上相对机械移动的装置（未显示），控制装置 6，抗振系统 7，用来对工作区域防尘保护的装置 8。此外，装置可包括自动进给到工作台上并从工作台上移开工作基片的系统，LLC 和工作区域恒温器，以及任何其它提供基片自动处理，提高偏振镜质量或装置生产率的系统和机械。在图 1 中，带状干燥系统位于形成系统和定位清除系统之间，并在清除时提供最佳偏振层水分。但是，定位清除偏振层的系统可直接位于涂敷系统之后或之上，在所需部位从基片上除去 LLC 的湿膜。

根据显示器的结构，一般地说，偏振膜的偏振轴相对于其它部件的光轴的一定的取向是必要的。这就有必要在与矩形基片的边的夹角不是 0° 和 90° 的角度上涂敷偏振镜。因此，用于放置基片的工作台，可具有相对于移动方向水平旋转其平面的装置。

装置所进行的主要操作：预先将 LLC 溶液涂敷到基片上、其在表面上分布成为薄取向层、附加的取向、改变基片的取向到所需的角度、偏振膜材料的定位清除、旋转基片 90° ，然后是第二次偏振膜材料的定位清除。取决于于基片的边的取向相对于移动方向的角度，还根据偏振镜的涂敷方法，某些操作可省去或同时进行。在更普通的情况下，当基片随机取向时，偏振膜的涂敷分两步进行：在整个工作基片（它可进一步在显示器中用作一个片）的表面形成连续的涂层，然后清除偏振镜，只在需要的位置保留它的部分表面。装置的操作顺序如图 1 中所示。基片位于工作台 2 上，而 LLC 涂敷到其上。当基片移动时，就形成偏振涂层，并且，如果必要，进行附加的取向。在基片离开涂敷系统后，它从其边的取向相对于移动

方向有角度的状态，旋转到那些边的取向平行于移动方向的状态。当进一步移动时，基片进入定位清除偏振膜的材料的装置 4 的操作区域，并且在希望的位置从基片上清除膜。到达装置的末端后，工作台转动 90° 并向回移动。这里，偏振镜的清除在垂直于第一次清除方向的方向上发生。工作台移动到最初位置后处理过的基片被一个新基片代替。在清除系统直接位于膜涂敷系统中的情况下，装置更加紧凑（具有更小的尺寸），因为基片的最大移动距离仅受基片的对角线尺寸限制，而在前面的情况下，这一距离是两倍之多。但是，在这一结构中，基片必须移动两个移动循环以完全完成偏振镜形成的过程：当从左向右移动时形成连续膜，当反向移动时第一次定位清除偏振镜，当第二循环的从左向右移动时完成第二次清除，以及一次空移以使基片返回初始位置。

为提高生产率，装置可具有这样的工作台尺寸，数个基片可置于其上。这里，装置可相应地具有多个涂敷和清除系统，以便在每个基片上同时并独立地形成偏振镜。

图 2 表示用来涂敷偏振镜的系统，其中产生偏振镜的取向膜的工作部件是棒。系统的主要部件是载物台 9，装备有工作基片的真空固定器的工作台 10 和传输系统的滑架 12 位于其上。工作台应该装备有用来准确放置基片的支持物。滑架 12 起的作用是将棒 13 用夹持器 14 固定在其上。棒夹持器必须达到其易于安装，刚性固定并且可调节地沿其整个长度均匀地夹紧基片的表面。除此之外，夹持器可具有固定在其上的部件 15，它提供 LLC 膜上的附加取向力。

载物台 9 也具有位于其上的系统 16，它用来以沿着棒的整个长度的线的形式涂敷 LLC 到基片上。用于 LLC 涂敷的系统 16 代表装有 LLC 的储存器，LLC 在需要的压力下经过管线通过已校准的针状喷嘴从其中涂敷到基片的表面上。喷嘴可沿其整个宽度以需要的速度跨越基片移动。对装置的控制由控制台 18 进行。

装置的载物台放置在具有抗振保护装置的工作台上。

装置的操作按下面的顺序进行。最初滑架位于最左边的位置，因而棒 13 在基片 11 的边界之外，并被支撑到高于它。此时用于涂敷 LLC 的系统 16 的喷嘴 17，通过它 LLC 被涂敷到基片上，位于基片的边缘上方的位置。在操作开始时，喷嘴降低到希望的高度，在压力下的溶液送进喷嘴的通道，并且，当溶液开始喷射到基片的表面上时，喷嘴开始以希望的速度跨越基片移动。涂敷材料的量将由压力和喷嘴的移动速度决定。当到达边缘位置后，喷嘴提起并回到起始位置。滑架开始移动，并且当它到达基片的边缘时，棒降下来并开始在基片的表面以希望的速度展开溶液。在这一过程中，部件 15 在湿膜上产生附加的取向影响，除去在分子取向中在偏振膜的涂敷相中由棒诱发的干扰。到达最左位置后，滑架停止。在这一过程中，棒提起随后滑架返回到起始位置。

棒可使用通常所说的迈耶棒（Mayer rod），带有紧紧地绕在其上的圆截面的标准的金属线的金属棒。这种棒允许得到必要厚度和高均匀程度的膜。在同时的分子取向具有某些由棒表面的周期性结构诱发的分布函数。这种分子取向分布函数使偏振特性变差，这在厚膜中尤其明显。附加取向部件 15 的引入可消除这一缺点，使分子的取向分布更加均匀。

用来附加取向的部件 15 是具有光滑或平滑表面的有机材料柔性薄片（或膜）。在偏振涂层的涂敷过程中，该片接触 LLC 的表面并在其上滑动，由于表面张力，在 LLC 的分子上产生附加的、在基片的整个宽度上均匀的取向力。选择片与 LLC 膜接触的长度，以便达到最好的分子取向，并且介于 1-500mm 的范围。

在装置中部件 15 相对于棒的连接可采用各种各样的方法。图 3 示意了部件 15 在棒 13 和基片 11 之间的放置。在这种情况下，使用带有弹性涂层的辊作为棒特别方便，因为它允许消除由在基片 11

的表面的干扰引起的偏振膜厚度的不均匀性。这在涂敷大尺寸基片的过程中尤其重要，这里由于基片本身以及棒的轴的不可避免的弯曲，很难提供棒对基片表面的均匀夹紧。偏振镜涂层的厚度因而将由棒的弹性涂层的弹性、棒的移动速度、LLC 粘度和将棒向基片的压力决定。

图 4 表示了在偏振作用的光轴应该与显示器的边缘做成一定的角度（从 0° 到 90° ）的情况下用来涂敷偏振涂层的装置。偏振涂层的形成在两步中发生。第一步，涂敷辊 **19** 涂敷一层染料到基片 **11** 上，然后染料被聚合物片 **15**，通过弹性辊 **20** 压向基片，按所需厚度形成涂层并取向。染料 **21** 由辊 **22** 提取并传送到中间辊 **23** 上，其表面进行了加深以便突出的部分在基片上留孔。染料，在突出的部分上会被传送到涂敷辊 **19** 上，并进一步到基片 **11** 上。基片用真空固定在旋转工作台 **24** 上。膜的涂敷和取向在工作台的移动过程中发生。当基片移动到涂敷系统的边界之外后，工作台旋转一定角度，以便基片的两个边平行于工作台的移动。然后工作台接着移动，并且基片进入用来在必要区域清除偏振镜的装置。

图 5 图示了两例用来定位清除偏振膜材料的装置的执行过程，基于一个原理：在需要的区域用水稀释膜及用真空泵清除。差别仅在于在其进给到基片的所需区域的过程中用来产生附加水压的方法。在图 5a 所示的系统中，水可在多种方法产生的压力下进给；在图 5b 所示的第二种系统中，水的压力是由真空吸力产生的。

在图 5a 所示的装置中，水从蓄水器 **25** 经泵 **26** 进给到管路 **27** 中，然后它稀释染料膜，并通过管路 **28** 被真空泵除去。

在图 5b 所示的装置中有一个管路，在基片 **11** 一侧开口。在装置接近基片的过程中，在管 **30** 中产生负压，水从蓄水器 **31** 吸入到管路 **29** 中，然后它稀释染料膜并通过管路 **30** 除去。阀 **33** 控制进水量。

不考虑使水产生附加压力的方法，这种工作部件可组合成复合部件（图 6）。在这种情况下，它们将同时工作并呈带状地清除偏振镜膜或一组膜。在涂敷装置中安装两组这种部件将是合适的，其一在工作台向前移动的过程中起作用，而另一组在向后移动的过程中起作用。因此在一组中部件之间的距离与显示器的宽度对应，同时在另一组中与显示器的长度对应。

在两种情况下，所提议的装置都允许清除偏振膜而与其水分含量无关。膜的最佳水分含量是选择高速清除、保持锐边和在边缘区域中的高度取向的条件。

实现这种偏振镜清除方法的可行性的条件，决定于偏振镜材料的稀释速率和生成、溶液的清除速率与偏振层的涂敷速率的对比。涂敷的速率依赖于 LLC 溶液的粘度，可从 5 到 200mm/秒。对于这一速率范围以及在水进给和真空泵通道之间的 1cm 的距离，在水和偏振镜之间的接触时间在 2 到 0.05 秒之间。根据经验表明，控制给水速率和施与溶液的真空，有可能达到大约 1μm 厚的干燥偏振膜的完全清除，由此证明这种方法对于定位清除偏振涂层的技术可行性。

进行的研究已经确认了得到的偏振涂层的高质量，高度的各向异性和高偏振效率。在定位清除偏振材料的过程中，所保留区域的边缘和表面具有理想的结构，并且区域自身在其范围内具有均匀的厚度。调查表明，确实达到了上面列出的每个装置的技术结果。

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01.07.11

说 明 书 附 图

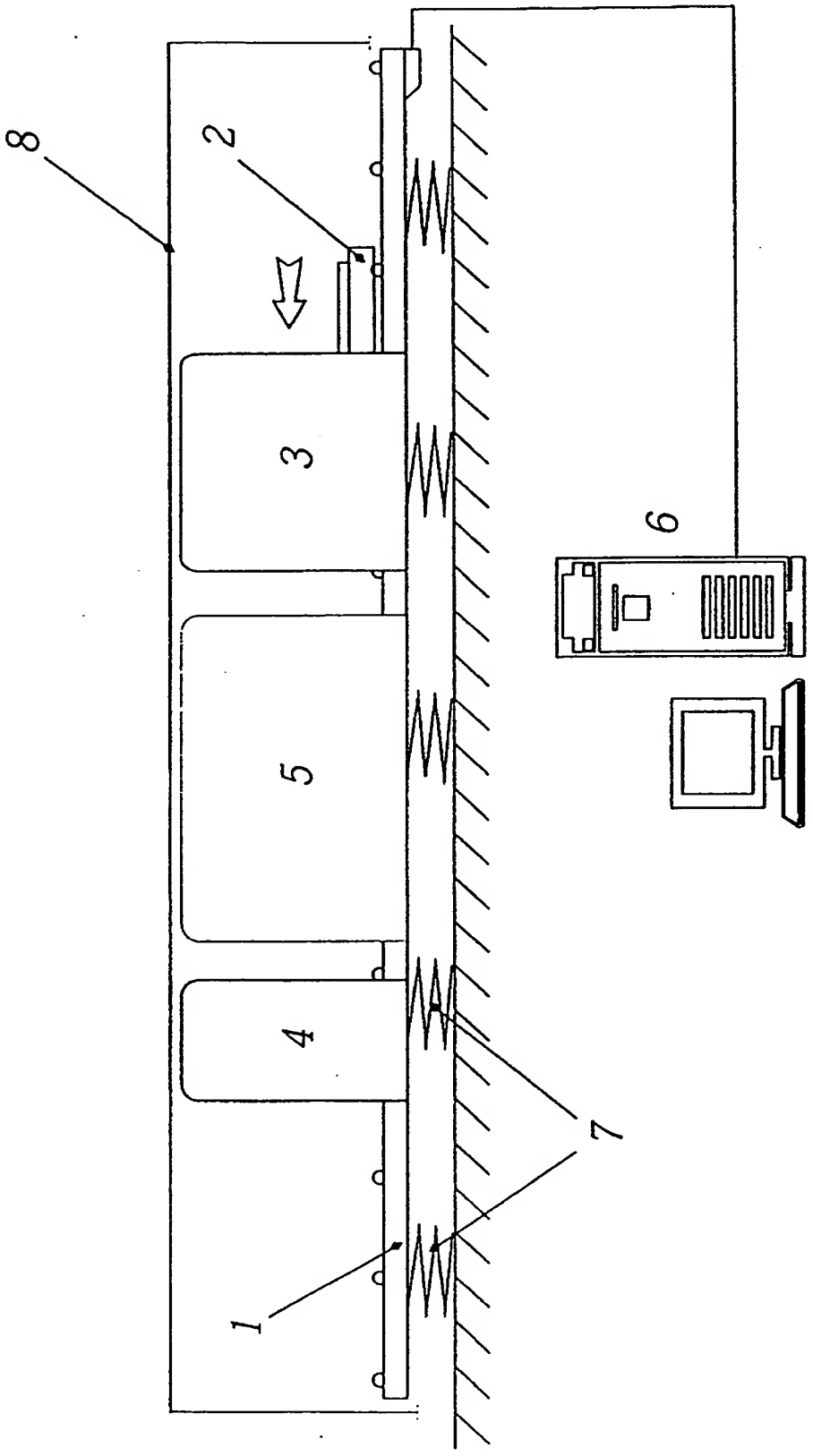

图 1

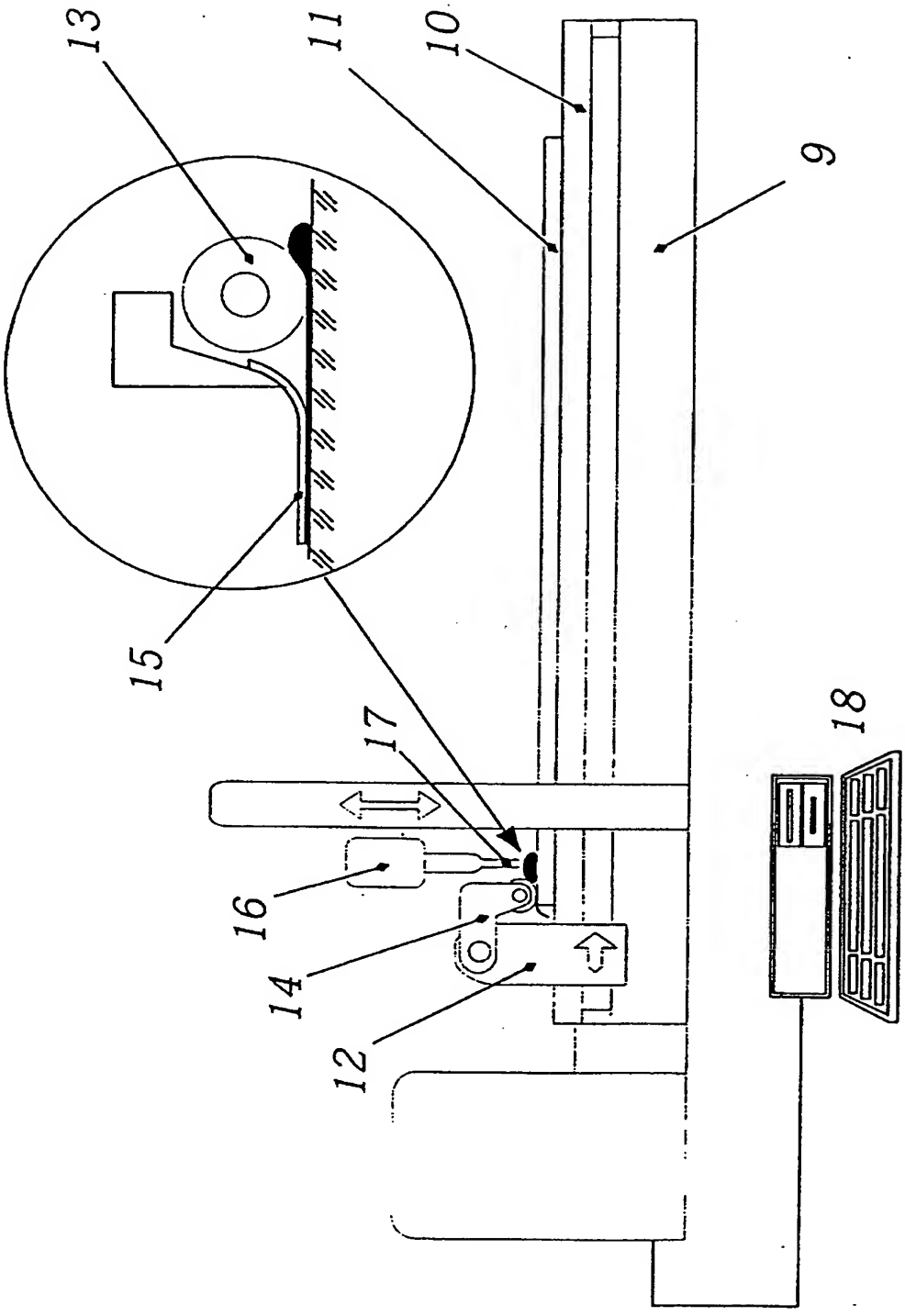

图 2

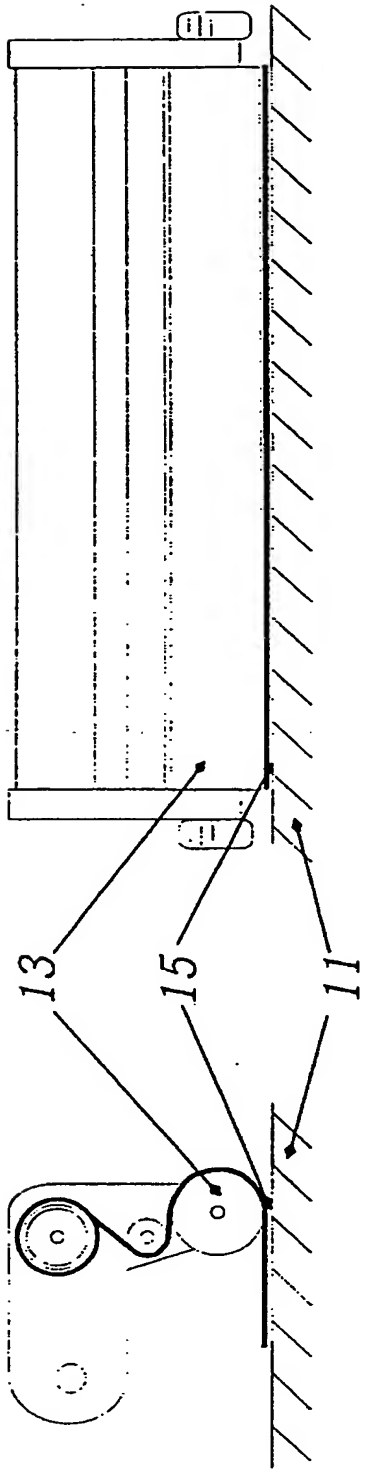

图 3

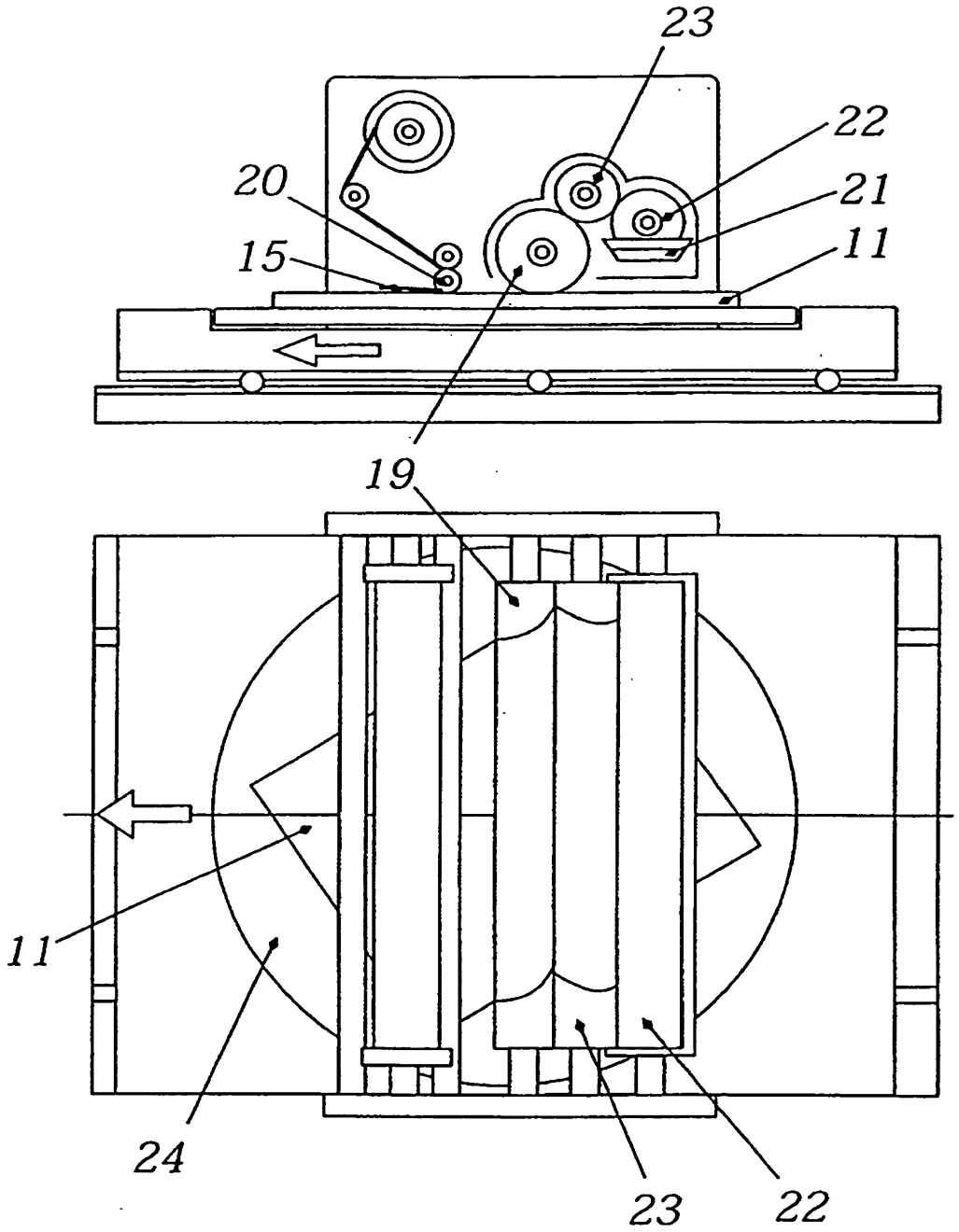

图 4

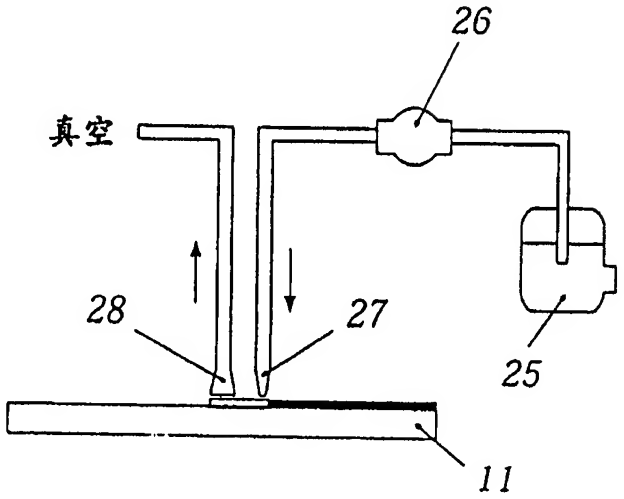

图 5a

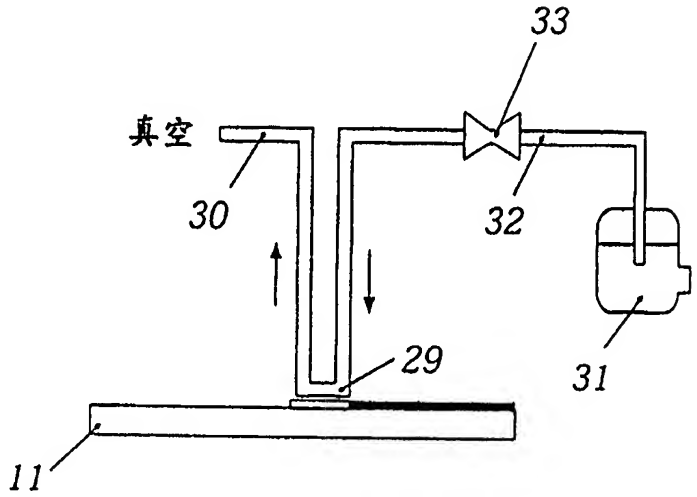

图 5b

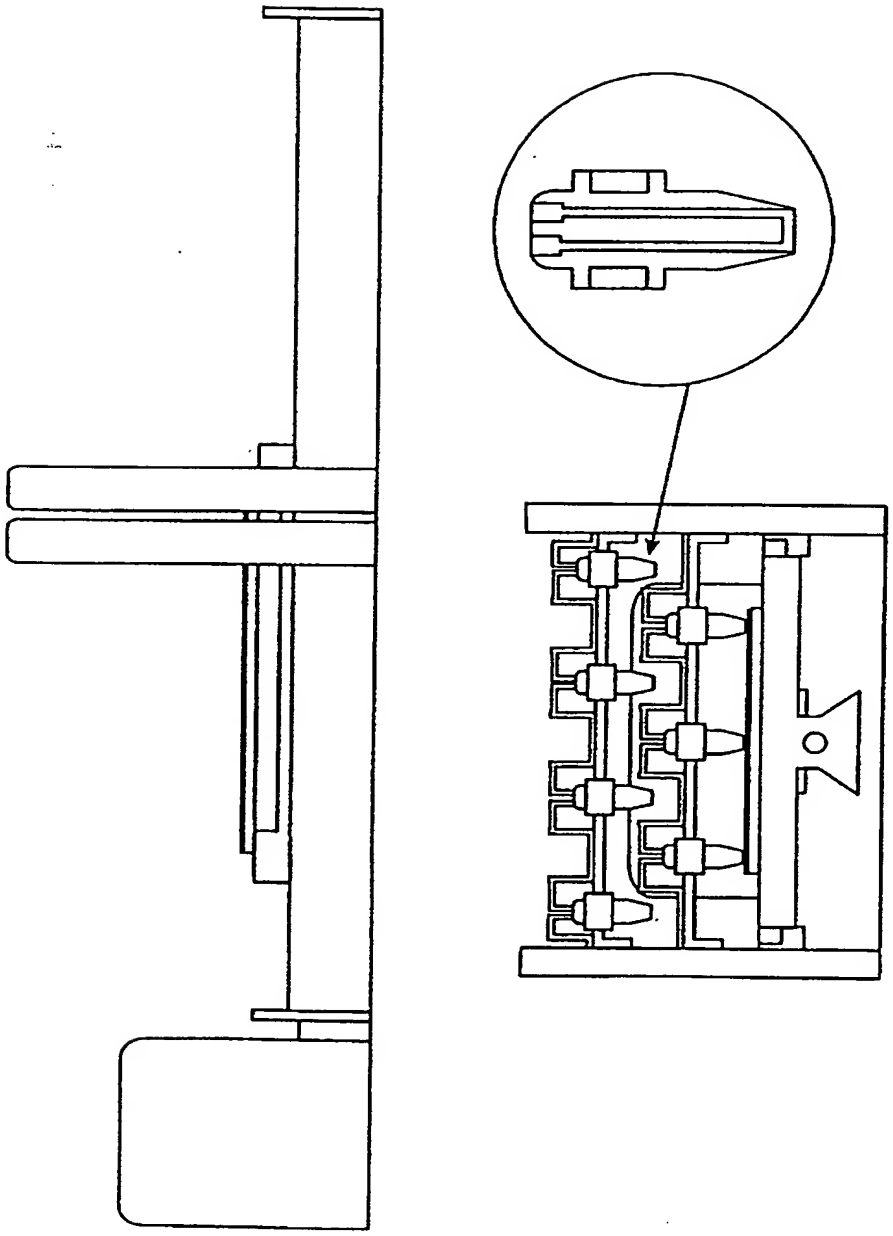

图 6